A Q U A P H Y T E

CENTER FOR AQUATIC PLANTS
Institute of Food and Agricultural Sciences
University of Florida

With Support From
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Aquatic Plant Control Research Program

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CALL FOR REPRINTS

Join the hundreds who contribute reprints, reports and books to the **Aquatic Plant Information Retrieval System (APIRS)**. Your contributions will be added to the growing database, and made available to thousands of **APIRS** users. (See page 5)

FLORIDA LAKEWATCH - Volunteers Monitor Water Quality

What is the easiest, quickest and most economical method of gathering water quality data on Florida's more than 7,700 lakes? Ask Sandy Fisher, field director of Florida **LAKEWATCH.** She will tell you about the several hundred enthusiastic lake-dwelling volunteers who have joined the program to regularly collect data on Florida's lakes. In this way, volunteers and researchers learn about water quality changes that are occurring throughout the state. So far, about 100 lakes are being monitored by volunteers in the rapidly expanding **LAKEWATCH** program.

[See LAKEWATCH on page 2]

Scirpus californicus. **Preparing and distributing line drawings of aquatic plants** is another service of the Aquatic Plant Information Retrieval System (APIRS). Botanical illustrator Laura Reep is the artist. For information about borrowing and using these drawings, see page 14.

PROHIBITED AQUATIC PLANTS

New Manual for Inspectors

There are thousands of aquatic plant species world-wide. Some of them are "cosmopolitan" and occur almost everywhere. Other plants have limited distribution and can survive only in special situations. Still other plants grow prolifically in many habitats and are limited to their native ranges only by geography.

But with the growth of the aquaculture and aquarium industries, coupled with "same-day" intercontinental delivery services, the chances for greater distribution of noxious plants increase.

One goal of the **Bureau of Aquatic Plant Management** (Florida Department of Natural Resources) is to prevent the introduction of non-native weedy plants into Florida's waters. The Bureau has the task of determining which of thousands of species of exotic aquatic plants are likely to threaten the

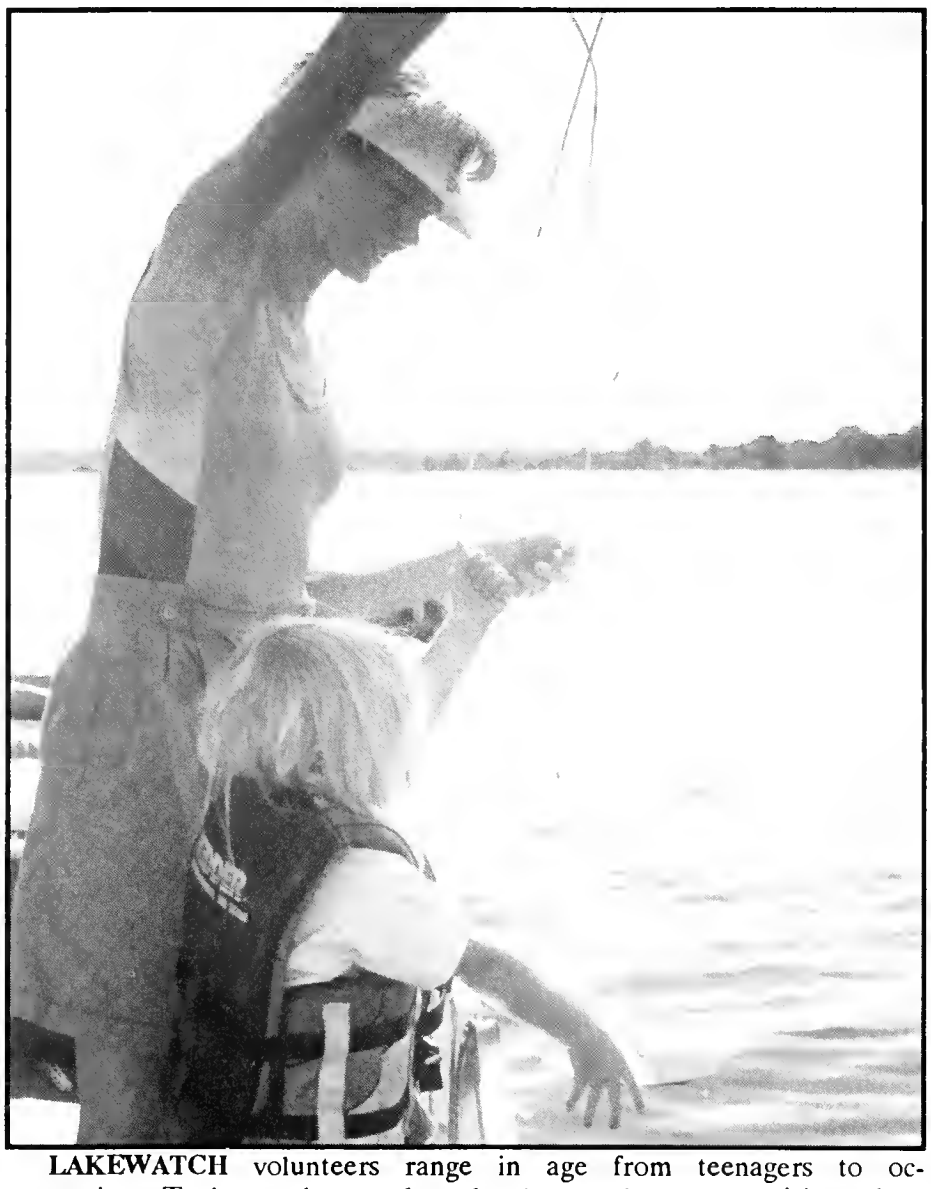
[See PROHIBITED PLANTS on page 4]

[From LAKEWATCH on page 1]

Florida **LAKEWATCH** is important because little water quality information has been collected for the majority of Florida's lakes. For many lakes, data is being gathered for the first time. As data is accumulated, the record can be watched for patterns and changes. Problems may be spotted before they get out of hand and management techniques considered. Similar programs exist in other states, such as Minnesota, Vermont and New York.

Besides being an important information gathering mechanism, Fisher believes strongly in the educational aspects of the program. She feels that people who are knowledgeable about their lake will become actively involved in its management and future. For residents new to Florida, the program introduces important aspects of Florida's unique ecological systems.

Volunteers are taught to take Secchi depth readings monthly to measure water clarity. Water samples, also taken monthly, measure nutrient content. Volunteers also filter the water samples for chlorophyll a content.



LAKEWATCH volunteers range in age from teenagers to octogenarians. To learn what needs to be done, volunteers participate in a two-hour training session given by Fisher at their lake. Monitoring stations are established, usually three per lake, and a sampling kit and instruction booklet are left with the participants.

Collected samples are brought to the water chemistry lab at the University of Florida Department of Fisheries and Aquaculture at the Center for Aquatic Plants where they are analyzed for total nitrogen, total phosphorus, and algae content by university chemist, Ms. Mary Rutter, and co-workers. Later, **LAKEWATCH** members are provided information about the nutrient and algae contents and water clarity of their lakes both by follow-up visits from Fisher and by a newsletter, **THE FLORIDA LAKEWATCH NEWSLETTER.**

A concerned lake-dweller herself, Sandy Fisher learned about sampling lake water after asking UF professor Dr. Dan Canfield for advice about her own lake in Alachua County. After initiating the program, Fisher joined the staff at the University of Florida as an assistant-in-limnology.

Contact Ms. Sandy Fisher at the IFAS Department of Fisheries and Aquaculture, 7922 N.W. 71st Street, Gainesville, Florida 32606, (904) 392-9613.

A T T H E C E N T E R

In Florida, as elsewhere, certain aquatic plants are harvested and used for thatching roofs, weaving mats, "caning" furniture, etc. One species is bulrush (**Scirpus californicus**).

How does yearly cutting and harvesting affect the biomass production of bulrush? In a three year study, researchers will measure the effects of harvesting frequency and timing on bulrush growth. Above, Mr. Chuck Hanlon, assistant in aquatic plants, weighs a bundle from one of the control plantings.

Students from a variety of disciplines, including environmental engineering, wildlife, soils, fisheries, wetlands and others were attracted to the class, **Ecology and Physiology of Aquatic Plants.**

The course was taught by Drs. George Bowes (Botany), Alison Fox (Agronomy) and William Haller (Agronomy).

Hydrilla, Sedimentation and Tubers

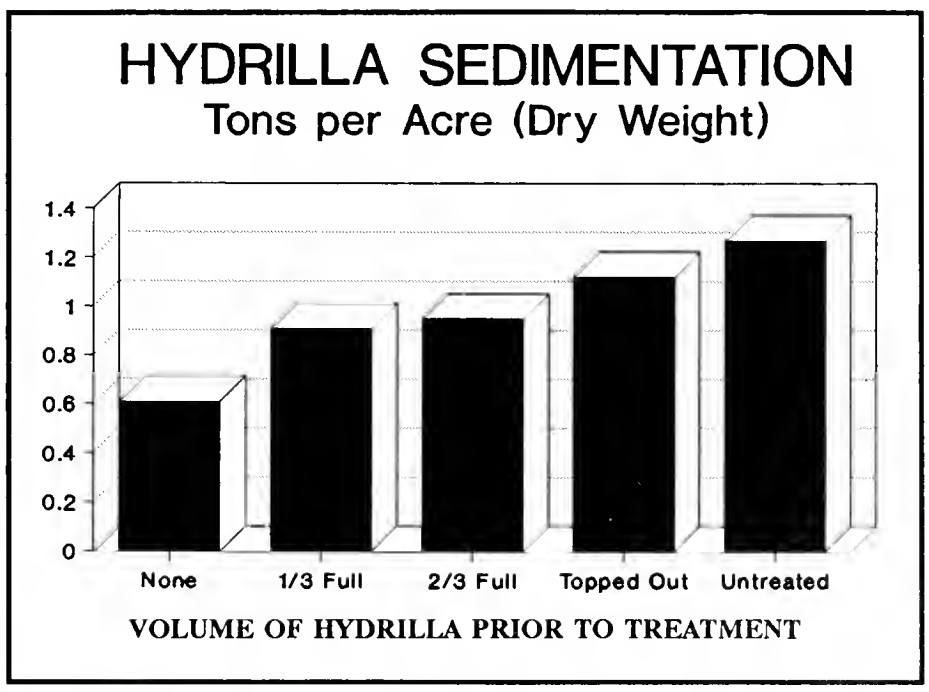
New research shows that uncontrolled hydrilla significantly increases organic sedimentation in natural systems. The results also "indicate that maintenance management of hydrilla over an extended period of time should decrease the rate of organic sedimentation and decrease hydrilla tuber production and residual tuber density in the hydrosoil."

In tank studies, researchers found that uncontrolled hydrilla contributes as much as 1.27 tons (dry weight) of organic sediment per acre, more than twice as much as the non-macrophyte controls.

The data also showed that treating hydrilla with herbicides greatly reduced the production of tubers, relative to "topped out" and untreated hydrilla.

The results of this work parallels the results of previous work on the effects of maintenance control on water hyacinths, which showed that hyacinths under maintenance control also contribute much less sediments than they would if left to infest a water body.

The hydrilla research was conducted at the Ft. Lauderdale research station by J.C. Joyce, K.A. Langeland, T. Van, and V.V. Vandiver, Jr.



Uncontrolled hydrilla contributes significantly more sediment to the substrate and produces significantly more reproductive tubers than does hydrilla regularly treated with herbicides. The graph shows that untreated hydrilla contributes up to 1.27 tons (dry weight) sediment per acre.

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Dr. Joseph Joyce, Director

[From PROHIBITED PLANTS on page 1]

state; that is, which plants are known to proliferate in Florida-like environments.

These plants are placed on the Bureau's list of "Prohibited Aquatic Plants". It is against Florida law to import, transport, cultivate, possess, collect, or sell plants on the prohibited aquatic plant list. It is believed that enforcement of these laws is helping prevent new exotic aquatic weed infestations and helping slow the spread of many naturalized exotic plants.

Within the past year, the Bureau has made changes to its prohibited plant list. The list now includes 24 species and genera of "aquatic plants". Newly included in the list are two exotic tree species, melaleuca (*Melaleuca quinquenervia*) and Brazilian pepper (*Schinus terebenthifolious)*, both of which occur in wet sites in Florida.

To help inspectors of the various agencies, the Bureau commissioned the IFAS Center for Aquatic Plants to prepare and publish an identification manual, *FLORIDA PROHIBITED AQUATIC PLANTS.* The manual includes illustrations and descriptions of each plant. It is meant for outdoor use as well and is printed on water-proof, tear-proof paper.

FLORIDA PROHIBITED AQUATIC PLANTS

Alternanthera philoxeroides
Alligatorweed
Crassula helmsii
Swamp stonecrop
Eichhornia (all species)
Water hyacinth
Hydrilla verticillata
Hydrilla
Hygrophila polysperma
Hygro
Ipomoea aquatica
Water spinach
Ipomoea fistulosa
Lagarosiphon (all species)
African elodea
Limnocharis flava
Flowering rush
Limnophila sessiliflora
Ambulia
Melaleuca quinquenervia
Melaleuca
Mimosa pigra
Giant sensitive plant
Monochoria hastata
Monochoria vaginalis
Myriophyllum spicatum
Eurasian watermilfoil
Nechamandra alternifolia
Panicum repens
Torpedo grass
Pontederia rotundifolia
Tropical pickerelweed
Salvinia (all species except *S. rotundifolia (minima)*)
Salvinia
Schinus terebenthifolious
Brazilian pepper
Sparganium erectum
Exotic bur-reed
Stratiotes aloides
Water soldier, Water aloe
Trapa (all species)
Water chestnut
Vossia cuspidata
Hippo grass

For information about the manual, *FLORIDA PROHIBITED AQUATIC PLANTS,* contact the DNR Bureau of Aquatic Plant Management, 3917 Commonwealth Boulevard, Tallahassee, Florida 32303, (904) 487-2600.

OF MUSSELS AND PRAWNS

The **Brackishwater Aquaculture Information System (BRAIS)** provides aquaculture information services to researchers, extension officers, students and policy makers. It was founded in 1984 as part of the Southeast Asian Fisheries Development Center, Iloilo, Philippines, with partial funding from the International Development Research Centre of Canada.

BRAIS provides a number of information services including computerized bibliographic searches, document delivery, the bimonthly *Brackishwater Aquaculture Abstracts,* and the *BRAIS Newsletter.*

For more information, contact BRAIS, c/o Library, SEAFDEC Aquaculture Department, P.O. Box 256, Iloilo City, PHILIPPINES.

The fast-growing Brazilian pepper tree (*Schinus terebenthifolious*), above, has been added to the Florida Prohibited Aquatic Plants list. So has the melaleuca tree (*Melaleuca quinquenervia*).

APIRS FREE FOR YOUR USE

WHAT IS APIRS?

APIRS, besides being a rather unwieldy acronym for the **AQUATIC PLANT INFORMATION RETRIEVAL SYSTEM**, is an information sharing system. Specifically, APIRS is a computerized database of scientific literature about aquatic plants. The database contains over 27,000 literature references about all aspects of aquatic plants, including ecology, physiology, morphology, taxonomy, utilization, and more. For more than ten years, we have been adding to the collection by soliciting researchers for reprints of their work and by acquiring copies of literature through our own network.

WHAT DO WE DO?

Basically, we collect the research, we assign categories and keywords, and we enter the information into a database. We then redistribute this information to researchers, water resource managers, public agencies, students and members of the general public in the form of printed bibliographies. We also provide copies of the literature when users are unable to locate references through their own local sources. These services are provided at no charge to the user.

HOW DO WE DO IT?

Science reader and cataloger, **Mary Langeland,** scans bibliographies, publications lists, journals listings, proceedings, science newsletters, book listings and other databases for citations about any aspect of aquatic plant science. Once a copy of the reference is obtained, it is read by Langeland and assigned categories, keywords and plant names.

Information Specialist, **Jeri Friedman,** works tracking down copies of the research. She searches in the university library, writes to book publishers, professional societies and research centers, and requests reprints directly from researchers. In short, no stone is left unturned. If unable to locate a copy of a reference, we enter it into the database as CITATION ONLY, with the hope that someone who has a copy will take note and share it with us. After references are catalogued by Langeland, Friedman enters the information into the database.

What do we do with 27,000 research articles and books? Student assistant **Patty Mikell** files and refiles research alphabetically, according to first author name. She also provides free copies of research to individuals who are unable to obtain references using their own resources. Due to our limited budget, we restrict the numbers of copies provided to fifteen or twenty references, depending on the length of the documents requested.

WHY DO WE DO IT?

The goal of the literature collection is to provide bibliographies that are concise and specific to a user's request. For example, a researcher interested in the biological control of hydrilla using grass carp would receive a bibliography consisting of 110 citations. Someone interested in the use of water hyacinths for wastewater treatment would receive a bibliography containing 170 references. Fruits of aquatic plants, 96; effects of fire on aquatic plants, 41; Scirpus and seeds, 44; and so on. Literature searches are performed by Senior Information Specialist, **Karen Brown.**

STILL NO INTERNATIONAL SUPPORT...

To the more than 1,500 of you in 58 other countries who formerly received our information exchange services:

GREETINGS!

We are sending this issue of **AQUAPHYTE** to let you know that we are still in the aquatic plant information sharing business.

We continue to seek international sponsorship so that we can again provide our services to scientists throughout the world.

In the meantime, **THANK YOU** to those of you who continue to contribute your reprints, books and reports to the **APIRS** database.

HOW IS IT USED?

By its nature, aquatic plant literature includes information about many different disciplines. Consequently, the APIRS database is often "searched" for information on diverse topics such as lake eutrophication, restoration, wetland plant communities, aquatic plants for pollution control, fisheries, economics, nutritional values for animal feed, waterfowl habitat, host plants for disease vectors, shoreline stabilization, nutrient uptake, and many others.

WHAT DO YOU DO?

In exchange for these **free services**, we ask that users contribute reprints of research, reports, proceedings, projects and anything else produced about aquatic plants.

WHO PAYS FOR IT?

We are sponsored by the University of Florida, Institute of Food and Agricultural Sciences, the Florida Department of Natural Resources and the U.S. Army Corps of Engineers, Waterways Experiment Station, Aquatic Plant Control Research Program, with additional funding from the South Florida and St. Johns River Water Management Districts.

For more information, contact APIRS at the address shown on page 16.

Continuing Work of an Eminent Scholar

One of the hottest continuing debates among scientists, politicians, water managers, environmentalists, farmers and others in Florida concerns the effects of nutrient additions to Florida's lakes. Are excessive nutrients threatening our lakes? Will controlling nutrient inputs improve the water quality in our lakes? If so, which nutrients need to be controlled, and by how much? Or, conversely, are increased nutrient concentrations more a natural factor of water levels, wind action and Florida's naturally rich watersheds? Should scarce public money be spent to divert nutrient-rich agricultural and urban run-off away from our lakes?

"Although there is no conclusive experimental evidence regarding the effects of nutrient enrichment on Florida's lakes, it would be counter-intuitive to think that there is no effect," says eminent scholar Dr. Claire L. Schelske. Schelske is studying the effects of nutrients and nutrient limitations in Lakes Apopka and Okeechobee. He occupies the Carl S. Swisher Chair of Water Resources, University of Florida, Department of Fisheries and Aquaculture.

Schelske points out that little is known about how Florida's subtropical lakes respond to nutrient enrichment. Therefore, generalizations across lakes may not be possible, especially considering the diversity of lakes that exist in the state. Even after sound data are available, decisions on how to apply the results to management decisions will be complicated by multiple use demands on important water resources.

To determine whether or not increased nutrient input is harming Florida's naturally eutrophic lakes requires that many questions be answered. One of the questions Dr. Schelske is addressing is, "What are the limiting nutrients for phytoplankton growth in Lakes Apopka and Okeechobee?" 'Limiting nutrient' describes the relationship between nutrients and primary production; in other words, which nutrient is most responsible for the growth of phytoplankton in these lakes? The limiting nutrient is usually present in the shortest supply, indicating that it is being utilized by the phytoplankton. Growth of larger standing crops of phytoplankton is dependent on the availability of the limiting nutrient.

Another question to be answered is, "How will reduction of the limiting nutrient affect primary production, or the amount of phytoplankton produced, in the lake?" It is generally believed that primary production increases with nutrient enrichment, but is the reverse also true?

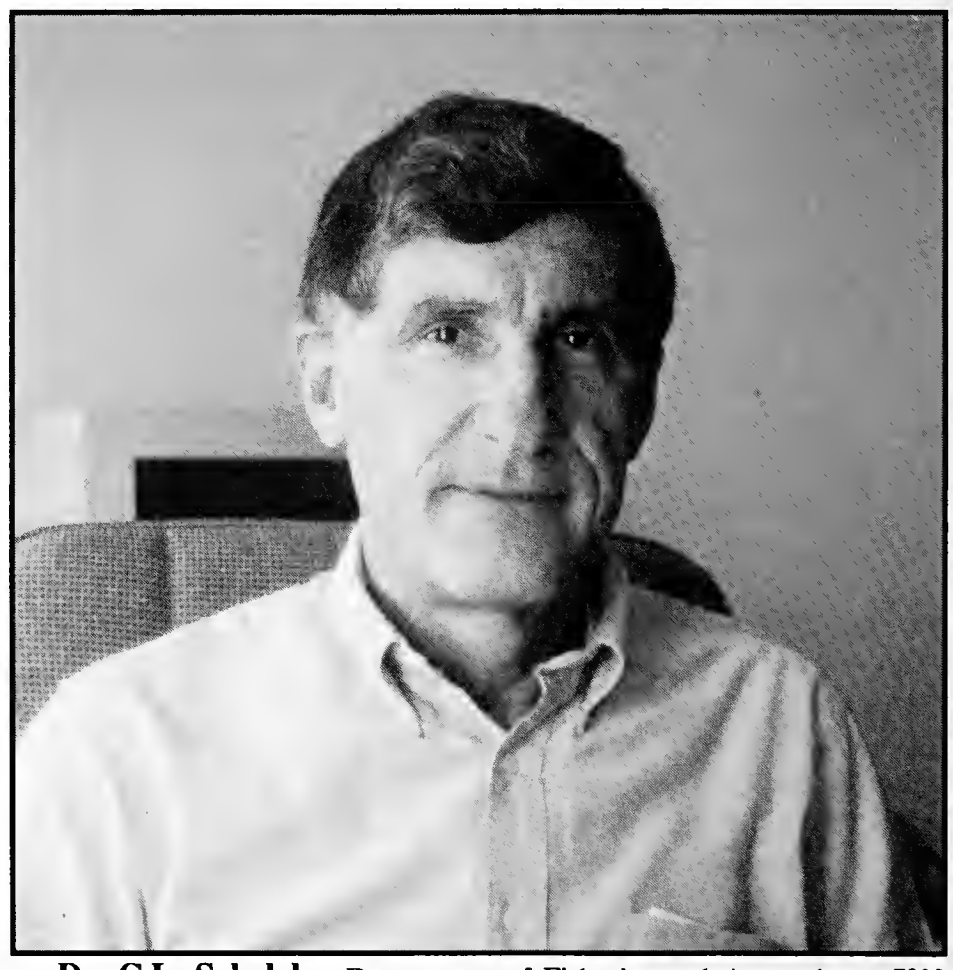
But the big question, according to Schelske, is "Can the limiting nutrient, once identified, be reduced enough to improve water quality?" The answers to these questions will be important in establishing management guidelines for the lakes, and will affect water use and management throughout Florida.

At present, preliminary studies on phytoplankton-nutrient interactions in Lake Apopka are being conducted in Schelske's laboratory using water samples from the lake. Later, experiments will be conducted on the lake over a period of one year so that seasonal effects can be considered. For these experiments, different nutrients are added to the water samples and the response of phytoplankton is measured. Says Schelske, "So far, the limiting nutrient in Lake Apopka appears to be nitrogen, but this may be due to the abundance of phosphorus. To reduce the impacts of nutrient enrichment, we may need to control phosphorous, since that is easier, which in turn would reduce the demand for nitrogen."

Schelske is also conducting studies of photosynthesis on Lake Apopka. Water samples in bottles shaded by various screen densities are being incubated at the lake surface to determine the photosynthetic response of phytoplankton to light intensity. Light intensity at depth is also measured. The results of both sets of measurements can then be used to determine the amount of primary production per unit of lake surface area. Data from these studies will help to establish a photosynthetic profile that can be used to estimate primary production in the lake.

Data from studies of primary production in relation to light intensity can be combined with results of studies on phytoplankton-nutrient interactions in predictive models. These models can be used to predict the lake's response to nutrient reductions. When completed, the models can be used by management and regulatory personnel to help solve the problems of Lake Apopka.

Biological scientist and doctoral student Mr. Rick Aldridge also works on the study, which is funded by the St. Johns River Water Management District SWIM fund. (The Surface Water Improvement and Management bill, signed into law in 1987, provides funds for the study and restoration of six of Florida's major water bodies, including Lakes Apopka and Okeechobee.) Similar studies are being conducted on Lake Okeechobee in collaboration with Dr. Edward Phlips of the Department of Fisheries and Aquaculture.



Dr. C.L. Schelske, Department of Fisheries and Aquaculture, 7922 N.W. 71st Street, Gainesville, Florida 32606, (904) 392-3185.

A Little Closer

Before his arrival at the University of Florida Department of Fisheries and Aquaculture in 1987, ecosystem scientist Dr. Claire Schelske was with the Great Lakes Research Division of the University of Michigan. One of his principal research interests is the paleolimnology of large lakes, or the tracing of lake history through the sediment record. Schelske has studied six of the 10 largest lakes in the world.

Schelske's other work includes completing paleolimnological research on some of the largest lakes in the world, with support from the National Science Foundation. The trophic states of these lakes range from eutrophic (Erie and Ontario) to ultra-oligotrophic (Superior and Great Slave). The two major purposes of the studies were to determine if the lakes have been affected by anthropogenic nutrient enrichment and, if so, to determine what effects have occurred and when. Results have shown that Lake Superior and Great Slave Lake have been affected by increased supplies of nutrients in the last 100 years. According to conventional wisdom and results of water column sampling, these lakes are generally considered to be pristine. However, careful study of the sediment record, which integrates the response of the lake with time, has shown subtle biological and chemical responses to nutrient enrichment. In Lakes Erie and Ontario, studies of the sediment record have shown that the lakes were affected soon after European settlement in the mid-1800s. Biological and chemical changes resulting from increased phosphorus loading at this time were more severe than is generally appreciated. These results show that the biological communities of large, temperate lakes are very sensitive to nutrient loading.

Dr. Schelske is an associate editor of the Journal of Great Lakes Research and president of the American Society of Limnology and Oceanography. He serves on committees for the York Distinguished Lecturer Series, the Upper Oklawaha River Basin Technical Advisory Group of the St. Johns River Water Management District, and the National Research Council Restoration of Aquatic Systems: Science, Technology, and Public Policy.

Selected Publications:C.L. Schelske

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FROM THE DATABASE

Here is a sampling of recent research articles, books and reports which have been entered into the aquatic plant database since September, 1989.

To receive free bibliographies on specific plants and/or subjects, contact APIRS at the address shown on the mail label on page 16.

To obtain articles, contact your nearest state or university library.

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Berkelhamer, R.C.; Bradley, T.J.
Mosquito larval development in container habitats: The role of rotting *Scirpus californicus*.
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JOURNAL OF THE WATER POLLUTION CONTROL FEDERATION, JWPCF, May 1989, 61(5):641-648, 1989.

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Alien vegetation and native biota in tropical Australia: The impact of *Mimosa pigra.*
BIOLOGICAL CONSERVATION 48(3):189-210, 1989.

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On the life cycle and germination of *Hottonia palustris* L. in a wetland forest. AQUATIC BOTANY 35:153-166, 1989.

Bronmark, C.
Interactions between epiphytes, macrophytes and freshwater snails: A review.
JOURNAL OF MOLLUSCAN STUDIES 55:299-311, 1989.

Buckingham, G.R.; Bennett, C.A.
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THE LAKE BOMOSEEN DRAWDOWN: An Evaluation of its Effects on Aquatic Plants, Wildlife, Fish, Invertebrates and Recreational Uses. 1990. 282 pp. A Report Prepared for the Vermont Legislature by the Vermont Agency of Natural Resources, 103 South Main Street Center Bldg., Waterbury, Vermont 05676.

In 1982, Eurasian watermilfoil (*Myriophyllum spicatum*) was found in Lake Bomoseen, Vermont (2,364 acres; average depth, 27 feet). Since then, it has spread to cover 600 acres of the recreational lake. Because of the great expense of mechanical harvesting two to three times per year, residents demanded that a drawdown be tried to control the nuisance weed. Subsequently, a seven month drawdown of 3.8 feet exposed 314 acres of lake bottom.

According to this report, the drawdown was a failure. Several reasons were cited: The milfoil mainly infested water deeper than four feet, where the drawdown had no impact. Milfoil plants that did grow in the exposed acres were significantly controlled, but some areas showed significant milfoil regrowth within three months of re-filling. The drawdown did "major damage" to the lake bottom and to other aquatic plants in the lake, reducing plant diversity and possibly actually increasing the competitive advantage of milfoil. The drawdown also caused "serious impacts on wetland wildlife abundance", "adverse and significant" impacts on mollusks, snails and other invertebrates, and eliminated at least one species of plant which had been proposed for legal protection in Vermont.

FLORIDA AQUATIC PLANT MANAGEMENT SHORT COURSE

JUNE 19-21, 1990

The purpose of the **Florida Aquatic Plant Management Short Course** is to provide training for new aquatic herbicide applicators and as a refresher course for more experienced applicators.

Topics that will be presented include:

Aquatic plant identification
Aquatic plant ecology and physiology
Biological control of aquatic plants
Mechanical control of aquatic plants
Aquatic herbicide technology
Calibration for aquatic herbicide applications
Environmental considerations in aquatic plant management

This year's course will be held at the University of Florida in Gainesville. It is sponsored by the Institute of Food and Agricultural Sciences (IFAS). For more information, contact the Center for Aquatic Plants, 7922 N.W. 71st Street, Gainesville, Florida 32606, (904) 392-9613.

BOOKS/REPORTS

THE HABITAT VALUE OF AQUATIC MACROPHYTES FOR MACROINVERTEBRATES by A.C. Miller, D.C. Beckett, C.M. Way and E.J. Bacon. 1989. Technical Report A-89-3, 96 pp., U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.
(Order from National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.)

Several Wisconsin studies are summarized here which report the effects of macrophytes on invertebrates, the colonization of invertebrates on *Potamogeton nodosus* and *Ceratophyllum demersum*, and the effects of macrophytes on distribution of zooplankton and invertebrate colonization. Among other things, the researchers found that invertebrates were seven to nine times more dense in plant zones than in no-plant zones.

ALLELOPATHIC AQUATIC PLANTS FOR AQUATIC PLANT MANAGEMENT; A FEASIBILITY STUDY by S.D. Elakovich and J.W. Wooten. 1989. Technical Report A-89-2, 40 pp., U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.
(Order from National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.)

The investigators subjected 16 aquatic macrophytes native to the southeastern U.S. to two bioassays. Of them, *Nymphaea odorata* and *Brasenia schreberi* were found to be "highly inhibitory and are therefore candidates for aquatic plant management." For example, *N. odorata* inhibited 90 percent of frond reproduction in the Lemna minor assay; *B. schreberi* inhibited 82 percent of radical growth in the lettuce seedling assay. One phenomenon seen in the study was that some plant extracts were inhibitory at one level, but acted as "growth stimulators at some much lower concentrations."

AN ECONOMIC ANALYSIS OF SPORT FISHING AND THE EFFECTS OF HYDRILLA MANAGEMENT IN LAKE COUNTY, FLORIDA by J.W. Milon and R. Welsh. 1989. Economics Report 118, 63 pp., Food and Resource Economics, University of Florida, Gainesville.

"Total economic activity" associated with Lakes Harris and Griffin was estimated to be $2.3 million per year. The survey showed that most anglers want hydrilla management on the lakes, but there are differing preferences for specific levels of control. However, anglers did express a "significant willingness to pay for controls."

PROCEEDINGS OF WORKSHOP ON MANAGEMENT OF AQUATIC WEEDS AND MOSQUITOES IN IMPOUNDMENTS March 14-15, 1989, University of North Carolina at Charlotte, edited by S.H. Kay and C.S. Apperson. 1989. Report No. 247, 147 pp., Water Resources Research Institute, North Carolina State University, Raleigh.
(Order from W.R.R.I., Box 7912, N.C. State University, Raleigh, N.C. 27695-7912. (919)-737-2815)

Eight of the twenty papers included in this proceedings have to do with the relationships between aquatic plants and their management and mosquitoes and their management.

CONSTRUCTED WETLANDS FOR WASTEWATER TREATMENT, Municipal, Industrial, Agricultural, edited by D.A. Hammer, Tennessee Valley Authority. 1989. 831 pages.
(Order from Lewis Publishers, 121 South Main Street, P.O. Drawer 519, Chelsea, Michigan 48118. $69.95.)

Here is an informative book about the theory and practice of designing, creating and using man-made wetlands. (It is also the proceedings from the First International Conference on Constructed Wetlands for Wastewater Treatment, Chattanooga, Tennessee, June 13-17, 1988.) This book's emphasis is on the more difficult pollution and water treatment problems posed by urban runoff, industrial effluents, agricultural wastes and mine drainage, rather than on the relatively simple tertiary treatment of municipal wastewater by wetlands.

The book includes 42 chapters in four general areas: wetland principles (such as hydrology, chemistry, and microbiology of wetlands); case histories; design, construction and operation; and reports of recent research that directly relate to wetland/wastewater systems.

WETLANDS ECOLOGY AND CONSERVATION: Emphasis in Pennsylvania, edited by S.K. Majumdar, R.P. Brooks, F.J. Brenner and R.W. Tiner, Jr., Pennsylvania Academy of Science. 1989. 395 pages.
(Order from Pennsylvania Academy of Science, Lafayette College, Easton, Pennsylvania 18042.)

Chapters are devoted to reviewing geology, soils, hydrology, chemistry and the plant and animal communities of Pennsylvania wetlands. Several chapters are devoted to wetland preservation. Other chapters detail wetland issues such as endangered species, mitigation and pollution abatement, and others explain Pennsylvania's procedures for wetland boundary delineation, permitting and restoration.

PERSONAL PROTECTIVE EQUIPMENT FOR PESTICIDE APPLICATORS "GUIDE TO SOURCES" by EPA, NIOSH, USDA. 1989. 227 pages.
(Order from National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, (703-487-4650).)

This is an easy-to-use nationwide listing of suppliers of personal protective equipment such as eyewear, headwear, gloves, other protective clothing and respirators. Separate listings are by state, manufacturer, and protective item.

WETLAND CREATION AND RESTORATION: THE STATUS OF THE SCIENCE, VOL. I: REGIONAL REVIEWS, AND VOL. II: PERSPECTIVES, edited by J.A. Kusler and M.E. Kentula, U.S. Environmental Protection Agency. 1989. V.I: 473 pages; V.II: 171 pages.

These volumes were written to "synthesize the knowledge accumulated to date into a statement of the status of the science of wetland creation and restoration," and also attempts to "set priorities for future research." Reviews in Volume I summarize wetland creation and restoration experiences within the U.S. The volume also contains a very good "Executive Summary" which presents 15 conclusions and 14 recommendations for wetland creators and restorers.

Volume II contains a dozen "perspectives" covering general topics related to wetland creation and restoration.

FEDERAL WETLAND REGULATION Reference Manual, edited by B.N. Goode and R.J. Pierce. 1990. 283 pp.
(Order from: Wetland Training Institute, Inc., P.O. Box 1022, Poolesville, Maryland 20837-0099, (301) 972-8112. $30.00 plus $3.00 shipping and handling; Maryland residents add $1.50 sales tax.)

This soft cover manual would be of use to managers who must operate within the federal 404 wetland regulatory program, administered by the U.S. Army Corps of Engineers.

The manual is a collection of the essential federal laws, regulations, and guidelines, and includes some interagency memoranda of agreement, guidance letters, and executive orders. It also contains a section on important judicial rulings relating to the program. Subject indices for the Corps' regulations and the guidance letters are also included.

LONG-TERM MONITORING PROCEDURES MANUAL, MARSH ECOLOGY RESEARCH PROGRAM, edited by E.J. Murkin and H.R. Murkin, Delta Waterfowl and Wetlands Research Station, and Ducks Unlimited Canada. 1989. 63 pages.
(Order from Delta Waterfowl and Wetlands Research Station, R.R. 1, Portage la Prairie, Manitoba CANADA R1N 3A1. Technical Bulletin 2. $8.00)

The Marsh Ecology Research Program (MERP) is internationally known for its work in northern prairie marshes. MERP studies the ecological processes that affect the distribution and abundance of wildlife and plants in the Delta Marsh (south-central Manitoba), and are particularly interested in the effects of water level fluctuations and wet-dry cycles. This manual describes the procedures used in their studies.

Included are their data collection procedures for climate, the physical environment (soil particle size, suspended solids inflow and outflow, etc.), hydrology (water inputs and outputs), nutrient dynamics, algal primary production, macrophyte production, decomposition, and vertebrate and invertebrate sampling. Also included are samples of data sheets used by MERP.

EDUCATIONAL VIDEOTAPE PROGRAMS

Management of the state's freshwater systems is a topic about which almost every Floridian has an opinion. Public meetings and hearings about aquatic plant management, fisheries, water level manipulation, water pollution and other issues draw thousands of residents a year. Residents want to learn more about the issues, and to be assured that their government agencies are handling complex water problems in the safest, fairest and most efficient ways.

At the same time, employees among different agencies also need a common knowledge base. Employees from each "water agency" often do not understand or appreciate the work of employees of other "water agencies," and in Florida there are about 150 local, state and federal agencies which manage various aspects of the state's freshwaters.

To help meet these educational needs, a videotape program production unit has been established at the University of Florida Center for Aquatic Plants. The goal of the unit is to produce a number of educational videotape programs for the general public and agency personnel about aspects of aquatic plant management and related issues. The unit is sponsored by the Bureau of Aquatic Plant Management of the Florida Department of Natural Resources, and is funded from the Aquatic Plant Trust Fund.

Three programs have been produced so far, and others are in production:

FLORIDA'S AQUATIC PLANT STORY. Produced for general audiences, this "overview" describes the benefits of native aquatic plants, recounts problems caused by some exotic "aquatic weeds", and introduces the major methods of aquatic plant management, including mechanical, biological and herbicidal controls. (25 minutes - Available in May, 1990)

CALIBRATION - A Field Approach. Produced for aquatic herbicide applicators, Dr. William Haller "takes the mystery out of" calibrating handguns, booms and granular spreaders. (35 minutes)

ISTOKPOGA - Lake of Legends. This program for general audiences describes the effects of a hydrilla infestation on Florida's fifth largest lake, and what citizens and agencies did about it. (39 minutes)

All programs are available in VHS and S-VHS video formats. These programs are free to cooperators in the Florida DNR aquatic plant control program. For others in Florida and the U.S., the cost is $10.60 each (the cost of duplication, handling and mailing). Pay to the order of the University of Florida. Order from APIRS, address on page 16.

In the studio are Phil Chiocchio, Director, and Wendy McDowell, Assistant.

Florida Game & Fish and Hydrilla

Survey of GFC Biologists

Among agencies and user groups the controversy does not actually "rage", but in Florida there is definite disagreement about how much a bad thing might be a good thing, or vice versa.

I'm referring to the fast-growing exotic aquatic plant *Hydrilla verticillata*. This plant excites Florida's swimmers, fishermen, duck hunters and aquatic resource managers in different ways; some like it a little or a lot, some don't like it at all.

What do the fisheries biologists of the Florida Game and Fresh Water Fish Commission think about hydrilla? Recently, biologists of the GFC's Division of Fisheries gathered for a "Hydrilla Management Philosophy Session". Questionnaires filled out during the session revealed certain beliefs about hydrilla. Here are some results of that survey, as compiled by GFC biologist Bruce Jaggers.

Perhaps the most significant finding of the survey of 35 GFC fisheries biologists is that the majority of them believe "we should allow hydrilla to expand in systems that have no aquatic plants" (**yes:14; no:12; maybe:7; other:2**). At the same time, not a single one felt that hydrilla should be allowed to expand into systems that have "diverse and/or abundant native plant species" (**yes:0; no:32; maybe:0; other:3**).

Other beliefs of GFC fisheries biologists:

- most believe "hydrilla would benefit the sport fishery" of Florida's hypereutrophic Lake Apopka (**yes:21; no:4; maybe:5; other:4**).
- the overwhelming majority believe "grass carp should be used to manage hydrilla" (**yes:28; no:2; maybe:5**), and many believe grass carp should be stocked "in systems having less than 5% hydrilla coverage" (**yes:11; no:16; maybe:6; other:2**).

Although not addressed in the survey, the GFC is conducting research on how to consistently keep in balance grass carp's consumption of hydrilla and desirable native plants.

MEETINGS

5TH ANNUAL FLORIDA LAKE MANAGEMENT CONFERENCE. June 14-15, 1990, Polk Community College, Winter Haven, Florida.

The conference theme is: Lake Management and Funding.

For more information, contact Lakes Education/Action Drive (LE/AD), 1720 South Florida Avenue, Lakeland, Florida 33803, (813) 688-2730.

INTERNATIONAL CONFERENCE ON USE OF CONSTRUCTED WETLANDS IN WATER POLLUTION CONTROL. September 24-28, 1990, Churchill College, Cambridge, UNITED KINGDOM.

This conference is about the use of hydrophyte-based systems for sewage, mining and industrial wastewater treatment.

For more information, contact Eric Porter, Conference Organiser, Water Research Centre, P.O. Box 16, Marlow, Buckinghamshire SL7 2HD, UNITED KINGDOM.

AQUATIC ECOSYSTEMS IN SEMI-ARID REGIONS; IMPLICATIONS FOR RESOURCE MANAGEMENT. August 27-30, 1990, Saskatoon, Saskatchewan, CANADA.

This meeting is being sponsored by the National Hydrology Research Institute and the Rawson Academy of Aquatic Science. For more information, contact Scientific Information Division, National Hydrology Research Institute, 11 Innovation Boulevard, Saskatoon, Saskatchewan, CANADA S7N 3H5.

11TH ANNUAL MEETING OF THE SOCIETY OF WETLAND SCIENTISTS. June 4-8, 1990, Beaver Run Resort, Breckenridge, Colorado.

The agenda will include speakers, papers, posters, training sessions, panel discussions and field trips focusing on national wetland issues and research.

For more information, contact Gerry Horack, TGS Technology, P.O.B. 9076, Fort Collins, Colorado 80525, (303) 226-9413.

NORTH AMERICAN LAKE MANAGEMENT SOCIETY, 10TH INTERNATIONAL SYMPOSIUM ON LAKE, RESERVOIR AND WATERSHED MANAGEMENT. November 6-10, 1990, Sheraton Tara Hotel, Springfield, Massachusetts.

For more information, contact NALMS, P.O. Box 217, Merrifield, Virginia 22116, (202) 466-8550.

8TH INTERNATIONAL SYMPOSIUM ON AQUATIC WEEDS, EUROPEAN WEED RESEARCH SOCIETY. August 13-17, 1990, Swedish Agricultural University, Uppsala, SWEDEN.

The Symposium theme: Environmental issues in relation to aquatic weed control.

For more information, contact Keven Murphy, Department of Botany, University of Glasgow, Glasgow G12 8QQ, UNITED KINGDOM.

25th ANNUAL MEETING OF THE AQUATIC PLANT CONTROL RESEARCH PROGRAM (APCRP). November 26-30, 1990, Marriott Hotel, Orlando, Florida.

For more information, contact J.L. Decell, Manager, APCRP, Corps of Engineers, Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199.

30TH ANNUAL MEETING, AQUATIC PLANT MANAGEMENT SOCIETY. July 15-18, 1990, Radisson Admiral Semmes, Mobile, Alabama.

MAKE PLANS NOW to attend the APMS annual meeting, this year in the heart of the historic Gulf-coast city of Mobile, Alabama. According to program chairman Joe Joyce, the first session will concern the ecological and environmental impacts of aquatic weeds: "why we do what we do." Subsequent sessions will include the latest developments in biological, mechanical, herbicidal and other methods of aquatic plant management. Attend the conference, then venture to historic sites and the famous nearby "sugar sand" beaches.

APMS is an international organization of scientists, educators, students and aquatic plant managers, and includes members from many federal, state and local agencies, and universities and corporations from around the world. APMS also publishes the *Journal of Aquatic Plant Management.*

For more information, contact the Aquatic Plant Management Society, Inc., P.O. Box 2695, Washington, D.C. 20013-2695.

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AQUAPHYTE

This is the newsletter of the Center for Aquatic Plants and the Aquatic Plant Information Retrieval System (APIRS) of the University of Florida Institute of Food and Agricultural Sciences (IFAS). Support for the information system is provided by the Florida Department of Natural Resources, the U.S. Army Corps of Engineers Waterways Experiment Station Aquatic Plant Control Research Program (APCRP), the South Florida Water Management District, and the St. Johns River Water Management District.

EDITORS: Victor Ramey
Karen Brown

AQUAPHYTE is sent to 3,500 U.S. and Canadian managers, researchers and agencies. Comments, announcements, news items and other information relevant to aquatic plant research are solicited.
We gladly permit free republication of *AQUAPHYTE* items when accompanied by full acknowledgement.

CONTRIBUTIONS TO AQUAPHYTE

Your colleagues elsewhere are more than interested in your work, facilities, special problems, special projects... Contributions of original articles or other items are welcomed for consideration for inclusion in *AQUAPHYTE*.

Material may be sent to the above address and should be no more than six typed, double-spaced pages. Articles also may be submitted on floppy disk in Word Perfect 5.0. Please remember to include photographs (preferably black and white 5" x 7" prints), graphs, or other materials to illustrate your contribution.

VIDEOTAPE PROGRAMS AVAILABLE

HANDLING PESTICIDES SAFELY - Rights of Way

This program teaches the basic rules for safely dealing with pesticides during storage, handling and application. It emphasizes label information and safety procedures, covering topics such as protective clothing, laundering, personal hygiene, application precautions, storage, transportation and mixing, and first aid. The videotape is accompanied by a brief study guide and quiz. Produced by American Cyanamid, the program is 13 minutes long.

Copies are available for LOAN from Dr. Mike Willis, American Cyanamid Company, P.O. Box 8459, Spartanburg, South Carolina 29305-8459, (803)582-1908.

LARGEMOUTH BASS RESEARCH IN FLORIDA

Homer Circle, angling editor and Fishing Hall of Fame member, hosts and narrates this look at several research projects conducted by the Florida Game and Fresh Water Fish Commission. The largemouth bass research projects include growth studies and the effects of size limits, the effects of an 11"-14" slot limit, the relationship between bass and hydrilla, angler attitudes about quality versus quantity fishing, and a study in which 48 taxidermists have been enlisted to collect data from trophy bass.

Produced by the Florida Game and Fresh Water Fish Commission, the program is approximately 18 minutes long. Copies are available for LOAN from any of the five FGFWFC Regional Offices. Contact your regional information officer or fisheries biologist, or Mr. William Greer, Audio-Visual Media Director, 418 Short Street, Tallahassee, Florida 32308, (904)488-4676.

AQUAPHYTE

UNIVERSITY OF FLORIDA
CENTER FOR AQUATIC PLANTS
INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES

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Toxicity Testing and Biomonitoring Using Aquatic Plants

by Wuncheng Wang, Illinois State Water Survey, P.O. Box 697, Peoria, IL 61652, (309) 671-3196

Regulatory agencies, industries, and consulting laboratories routinely use three "base-set" tests for toxicity assessment in compliance with the Toxic Substances Control Act, the Clean Water Act (and its section on the National Pollutant Discharge Elimination System), and other environmental laws. These tests rely on species of fathead minnow (*Pimephales promelas*), algae (*Selenastrum capricornutum*), and cladoceran (*Daphnia magna* or *D. pulex*) (Peltier and Weber, 1985; Horning and Weber, 1985; Weber et al., 1988). The reasons for selecting these species are apparent. First, the principal route-of-exposure of effluents, industrial chemicals, and other toxicants is waterways, so that aquatic species are frequently the first to bc cxposed to toxicity. Second, these species represent three important trophic levels. Third, there are ample data bases pertaining to these species. Regulatory agencies have relied on these tests as their tools for environmental protection. However, although these tests are widely used, they are impractical in some cases.

For effluent biomonitoring, it is essential to use either the renewal or the flow-through methods because effluent samples (especially samples of municipal effluents) are unstable as a result of large microbial populations and high organic content. Algac are not appropriate for use in either of these tests. In addition, filtration of turbid samples or samples containing large algal populations is required if they are to be evaluated by means of the algal test; however, sample filtration is undesirable because the procedure destroys the integrity of the test samples. Faunal tests (fish and cladoceran) also have drawbacks for effluent toxicity assessment. Some samples may contain low levels of dissolved oxygen, thus necessitating sample aeration, but like filtration, aeration violates the integrity of the test samples.

All these difficulties, however, are non-existent whcn aquatic, vascular macrophytes are used as test organisms. In addition to the case of using macrophyte tests, sevcral fcatures make them ecologically relevant. Along with algae, macrophytes are essential, primary producers in the ecosystem. They produce oxygen and organic matter, both of which are nceded by almost all other life forms in order to survive. Macrophytes frequently provide food, habitat, and shelter for waterfowl, insects, mollusks, amphibians, and mammals. Some macrophytes have important roles in nutrient cycling and in stabilization of shores or sediments.

Among macrophytes, duckweed is generally considered the most promising toxicity test organism. The plant is a small angiosperm and is extremely fast-growing (Hillman, 1961; Hillman and Culley, 1978). A detailed literature reviow regarding the use of duckweed for toxicity testing is available

[See TOXICITY on page 14]

Work on the **aquatic plant identification videotapes** continues. The programs feature aquatic plant expert Dr. David Hall, University of Florida Extension Botanist. See story on page 12.

VIDEO PROGRAM IN USE

FLORIDA'S AQUATIC PLANT STORY is the most recent environmental education program produced by the UF/IFAS Center for Aquatic Plants. The program describes the benefits of aquatic plants, recounts problems caused by some exotic "aquatic weeds", and introduces the major methods of aquatic plant management, including mechanical, biological and herbicidal control. The program is intended especially for general audiences and school students who have little knowledge of Florida's aquatic plants and their management.

We are very pleased that the program is being used in a variety of ways:

- Eleven television and cable stations in Florida requested broadcast quality copies of the program. One cable station aired the program several times during August.
- Twenty-two Florida school systems have purchased or borrowed the program for student use. One science coordinator determined that the program is appropriate for elementary and secondary schools and consequently requested 36 copies, one for each school in his district.
- A vocational high school teacher has developed a natural resources teaching unit around the program.
- The Florida Department of Education Instructional Television Office has offered to duplicate the program free of charge for requesting teachers throughout the state.
- The program has been purchased by a variety of environmental groups, including several Florida LAKEWATCH groups.
- The program is being used in environmental education forums such as the recent ECO-FAIR '90, sponsored by the Army Corps and the Take Pride in Lake Okeechobee Committee. Nearly 2,000 students and 100 teachers (grades K-8) attended the one-day forum.
- The program has been used for Army Corps training purposes in Texas, Tennessee and Minnesota.
- The program is also shown during public education meetings held by the Cooperative Extension Service.

FLORIDA'S AQUATIC PLANT STORY is one of a series of environmental education programs about aquatic plants and the management of Florida's freshwater ecosystems. The series is sponsored by the Florida Department of Natural Resources, Bureau of Aquatic Plant Management, with funds from the Aquatic Plant Trust Fund.

VHS, S-VHS or PAL copies of the program may be purchased for $10.60 ($10.00 for non-Florida residents) payable to the University of Florida. Order from:

IFAS Publications Office
IFAS Building 664
University of Florida
Gainesville, Florida 32611-0001
(904) 392-1764.

COMING SOON...

The Center video team is currently working with **Dr. Ken Langeland,** IFAS Aquatic Weed Extension Specialist, on a second calibration program. This new calibration program emphasizes the mathematics required to pass the Florida Certified Pesticide Applicator examination. The program will be available in early 1991.

Other programs in production include aquatic plant identification videos, featuring U.F. Extension Botanist **Dr. David Hall,** who teaches the identifying characteristics of 100 common Florida aquatic plants. The program will be divided into four tapes:

I. Floating and Floating Leaved
II. Submersed
III. Emersed
IV. Grasses, Sedges and Rushes

Programs will be announced as soon as they are available.

More than 2,000 students and teachers (grades K-8) attended the **ECO-FAIR '90,** September 19, 1990 in Clewiston. The fair introduced students and teachers to the federal, state and local agencies and organizations that provide environmental awareness programs in the Lake Okeechobee area.

A T T H E C E N T E R

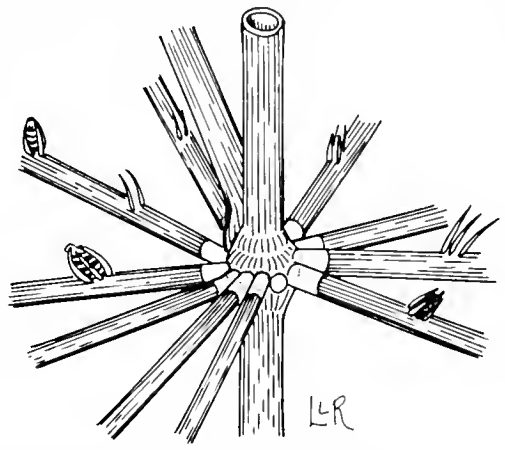
Continuing Studies On Torpedograss

Dr. Paul Thayer, in collaboration with Dr. Bill Haller, continues to investigate the troublesome Florida aquatic weed, torpedograss (*Panicum repens*).

In preliminary studies, Thayer has found that torpedograss will not resprout from the root system if it is cut or damaged when submerged more than one foot. Thayer believes disease organisms indigenous to Florida (the fungi *Phoma* and *Fusarium*) damage the plant stems in submerged conditions, and may serve as natural control agents in deeper waters where the plant cannot resprout. However, the fungi do not effectively control torpedograss in those situations where the weed grows best: shallow water or moist soil.

Torpedograss can survive in water depths up to four feet as long as the stems are not cut or damaged. This research may prove significant if Florida's water levels return to former heights and the torpedograss range extends out to four foot depths.

In other work, Thayer has been studying the effects of fluridone (Sonar) on torpedograss in drawdown situations. In a study initiated on West Lake Tohopekaliga in 1987, fluridone provided control through a two year evaluation period after the lake was drawn down, treated with the herbicide, and reflooded. Thayer is hoping to duplicate these results in studies on East Lake Tohopekaliga. Greenhouse tests have confirmed that greater weed control is achieved when the root system can be treated, instead of the foliar parts of the plants. Use of non-ionic surfactants with the herbicide further improved control.



"Stem" of muskgrass (**Chara** spp.)
Drawing by Laura Line, 1990

"Input" Wanted: Wetlands, Wildlife And Stormwater

Dr. Chuck Cichra, Fisheries Extension Specialist, is beginning work on a three year project that will result in an Extension publication entitled, "Designing Storm Water Control Ponds to Mitigate Wetland Habitat Losses," and an accompanying 30 minute video program. Since it is believed that storm water control ponds can serve many of the same functions as natural wetlands, the focus of the project is to relate how to design and manage ponds to retain water, be aesthetically pleasing, enhance fish and wildlife habitat, and provide recreational opportunities such as fishing, bird watching, and nature photography in developed areas. The publication and video program will contain information and species lists applicable at least to the southeastern portion of the U.S.

Topics to be covered in the project include regulations, site selection, liability, pond construction, fish and wildlife habitat and management, and pond landscaping and aquascaping. The investigators plan to consult with representatives from the water management districts and other regulatory agencies, environmental engineers, developers, landscape architects and other groups. Knowledge gained will be combined with that of the urban wildlife and fisheries specialists to produce these "how to" guides for future development activities, thus integrating fish and wildlife needs into the design, construction and management of storm water control ponds.

Input is solicited and anyone with information to offer may contact any of the investigators: Dr. Chuck Cichra (904/392-9617); Dr. Joe Schaefer (904/392-4851), Dr. Craig Huegel (813/586-5477) or Dr. Frank Mazzotti, (305/370-3725) of the U.F. Department of Wildlife and Range Sciences.

Canadian Studies Florida's Wild Rice

Canadian U.F. graduate student, **Jan Miller,** has begun studying the general biology and ecology of wild rice (*Zizania aquatica*) in Florida. An honor's biology student from Lakehead University, Miller is working on her master's project with Dr. Bill Haller.

The only cereal grain native to North America, wild rice is a cash crop in Canada and is considered a delicacy in many countries. In the U.S., California and Minnesota corner the market in wild rice paddy cultivation. However, very little biological information is available on the southern variety of wild rice. Besides adding to the existing body of knowledge on *Zizania aquatica*, learning about the growth characteristics may help scientists interested in developing hybrids.

Miller travels the state in search of wild rice plants, collecting seeds and data such as water temperature, salinity, and distribution. So far, the species has only been found in spring-fed or tidally influenced rivers. Plants are now being established in growth vaults for future studies.

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Dr. Joseph Joyce, Director

WATER QUALITY AND AQUATIC PLANT MANAGEMENT IN WAYNE COUNTY, NEW YORK (Sodus Bay, Lake Ontario)

by Robert K. Williams, Aquatic Program Coordinator, Wayne County Soil & Water Conservation District, 8340 Ridge Road, Sodus, New York 14551. (315) 483-6958

Within the Finger Lakes region of New York State there has been growing concern for the water quality of the area's freshwater resources. This concern was triggered mainly by the increasing abundance of aquatic macrophytes. In some cases over 500 grams (dry weight) per square meter have been recorded. Dominant aquatic plants include *Potamogeton crispus, Potamogeton pectinatus, Myriophyllum spicatum, Vallisneria americana,* and algae.

The Wayne County Soil and Water Conservation District (SWCD) has developed a comprehensive program to address both water quality and excessive aquatic plant growth. Three cooperating agencies provide the backbone for the program: the Finger Lakes Water Resources Board (WRB) which facilitates the exchange of information and maintains the integrity of similar programs in the region; the State Department of Environmental Conservation, Division of Water, which provides technical support; and the Cooperative Extension Service which supports the educational component.

The overall goal of the program is to manage aquatic plant growth on a long term basis and to restore water quality to a more acceptable level. Early in the program, the SWCD identified Sodus Bay as their primary waterbody to work with. Sodus Bay is the largest freshwater embayment along Lake Ontario's shoreline. The surface area of the bay encompasses over 3000 acres (1248 hectares) and has a watershed of just over 30,000 acres. The watershed is separated into five subwatersheds.

Through observation and review of limited historical data it appears that aquatic plant growth in the bay is accelerating. We believe the increased growth is a result of non-point sources of nutrients (NPS), and we have thus shaped our program efforts.

To effectively deal with the situation the SWCD has incorporated three key elements into the program: mechanical aquatic plant harvesting; non-point watershed research; and public education.

Mechanical harvesting provides the county with the means for immediate relief of aquatic plant infestations. To a limited extent, harvesting also removes some of the system nutrients (bound in the harvested plants). Two harvestors, each with ten foot cutting heads, are operated from June through September. An average of 1500 tons of vegetation are removed annually from three waterbodies. Results from 1989 are shown in Table 1 below.

"SILVERWATERS I" One of two harvesters operating in Wayne County. This photo shows the machine preparing to unload.

Table 1. Harvest results from 1989.

AREA	TONS REMOVED	ACRES HARVESTED
SODUS BAY	1075	248
PORT BAY	56	21
GANADA LAKE	4	2
TOTALS	1135	271

The long term benefits of removing excess vegetation, as related to nutrient removal, are currently being investigated. Each year the District evaluates nutrient removal via aquatic plants by multiplying the dry weight of harvested material by nitrogen and phosphorus values calculated from vegetation analysis. These values represent the average amounts of Kjeldahl nitrogen (N) and total phosphorus (P) contained in the Sodus Bay plants.

Table 2 represents nutrient removal in 1989.

Table 2. Nutrients removed, via harvesting in 1989.

AREA	N (lbs)	P (lbs)
SODUS BAY	1505	273
PORT BAY	78.4	12.3
GANADA LAKE	5.6	0.9
TOTALS	1589	286.2

In an effort to find a beneficial use for the harvested material the District is working closely with local organic farmers to study the feasibility of using the material in compost. Preliminary studies demonstrate that by mixing a 1:1 ratio of aquatic vegetation with a mixture of apple pumice, chicken manure and wood chips, soil organic matter is increased. Analysis of "aquatic compost" on a dry basis shows the following:

Organic matter	**.25%**
Total nitrogen	**1.43%**
T. Phosphorus	**.04%**
Potassium (K20)	**1.01%**
Calcium	**7.59%**
Sodium	**.07%**
Magnesium	**.26%**

An interesting observation made over the past two harvesting seasons is a shift in species dominance over the summer. We have found that in the first part of the season, late May through June, *Potamogeton crispus* dominates the harvest. By mid July, however, *P. crispus* was rarely observed. On the other hand *Potamogeton pectinatus* was relatively unnoticed throughout the summer but dominated the harvest in September. Future observations such as this may lead to information on changes in local plant community structure.

The second major element of the District program is monitoring water quality and managing non-point source pollution. We believe understanding our water quality is the key to controlling advanced eutrophication and excessive aquatic plant growth. In order to address our non-point sources of nutrients it is critical to gather scientific data on our waterbodies.

Currently two methods of collecting and assessing water quality are used: Fixed Frequency Sampling (FFS) and event-based monitoring/stream gauging. By regularly sampling watershed runoff we are able to assess water quality, develop historical and trend data, and compare each of the subwatersheds. With this baseline data, we will be better able to evaluate the effectiveness of future best management practices (BMPs). Currently all five tributaries entering Sodus Bay are sampled at a fixed frequency of once per week.

Event-based monitoring takes in-depth looks at the rclationship between storm events (rain and snow) and nutrient runoff into the Bay. This system consists of a stream gauging station equipped with an automatic sampler and other advanced instrumentation. In response to changes in water depth, the system takes water samples and records all relevant physical data. Measurements include stream height and discharge, total phosphorus, soluble reactive phosphorus, total Kjeldahl nitrogen, nitrates/nitrites, suspended solids and dissolved oxygen.

Data from various other in-lake studies allow us to compare the lake (bay) water to watershed runoff and better understand how water chemistry relates to water quality and weed growth. Water sampling also enables researchers to study trends in water quality and to track program success.

To help assemble our data into a realistic picture, the District will use a computer imaging system running the "GRASS" software developed by the U.S. Soil Conservation Service. This imagery system will allow researchers to view and study real and hypothetical land-uses and their potential impacts on our water quality.

Public education is the third key element of the District's program. In the program's first two years, we made more than twenty public presentations, keeping the public informed on local water quality issues as well as encouraging them to participate in program efforts. Any public service program must contain a public education effort in order to balance a program's implementation with public concerns. In Wayne County, a variety of educational strategies are incorporated into the program: video tapes, brochures, newsletters, and technical reports.

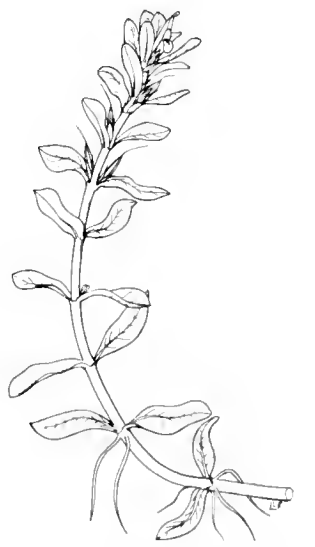
The three key elements, mechanical harvesting, non-point research and public education, combine to form a comprehensive program to manage aquatic plants and water quality on a long term basis in Sodus Bay, Lakc Ontario. Harvesting provides a means of immediate control of aquatic plants while non-point research looks to long term control. By taking a closer look at the Bay's watcrshed and incorporating best managment practices on the surrounding land, lake trophic state succcssion can bc bctter understood and controlled.

AQUARIUM PLANTS

It is commonly reported that hydrilla, the worst aquatic weed in Florida, was introduced into the state by people emptying their aquariums into canals in Crystal River and Miami. In the 1960s, hydrilla was sold for aquarium use as the "oxygen plant". The rest is history.

Despite the public education efforts warning of the dangers of exotic (non-native) aquatic plants, books and aquarium supply houses continue to promote the use of exotics in aquaria. One recently published aquarium book promotes the use of half a dozen exotic plants, plants that are listed on the Florida prohibited aquatic plant list including water hyacinth and *Limnophila.* Another aquarium book emphasizes the desirability of *Hygrophila polysperma* as an aquarium plant that can be easily propagated by cuttings, and also describes the pleasing green color of *Myriophyllum spicatum* (Eurasian watermilfoil). All these plants are prohibited exotics, some with the potential to be as much an ecological nuisance as hydrilla.

Some of these plants create only regional problems due mainly to climatic limitations. However, the aquarium industry, through its publications and catalogs, should take care in promoting known weed species.



Hygrophila polysperma

BOOKS/REPORTS

AQUATIC WEEDS - The Ecology and Management of Nuisance Aquatic Vegetation by A.H. Pieterse and K.J. Murphy, Oxford University Press. 1990. 593 pages.
(Order from Oxford University Press, 2001 Evans Road, Cary, North Carolina 27513, (919) 677-0977. $135.00 plus $2.00 shipping.)

This is a comprehensive and very readable new textbook on aquatic weeds. It is the result of an initiative of the Working Group on Aquatic Weeds of the European Weed Research Society (EWRS).

Thirty internationally recognized authors wrote the book's 20 chapters, which are divided into three main parts. "The first part is concerned with concepts, ecology, and characteristics of aquatic weeds and also includes chapters on flow resistance and the relation between aquatic weeds and public health. The second part covers the management of aquatic weeds, with chapters on various control methods, surveying and modelling of aquatic weed vegetation, utilization of aquatic weeds, and the relation between plant survival strategies and control measures. The third part deals with the present status of aquatic weed problems in the various continents."

AQUATIC PLANT BOOK by C.D.K. Cook. 1990. 228 pages.
(Order from SPB Academic Publishing, P.O. Box 97747, 2509 GC The Hague, THE NETHERLANDS. $55.00.)

The world's preeminent aquatic botanist has written a new book to replace his well-known *Water Plants of the World*. The large-format *Aquatic Plant Book* describes and illustrates 407 genera of vascular aquatic plants - "including all ferns and flowering plants that are likely to be found in or floating on permanent or semi-permanent, fresh or salt water anywhere in the world."

The identification keys are based on easily seen vegetative characters. Descriptions include information on juvenile forms, distribution, like forms, ecology, pollination mechanisms, uses, economic importance and references to the literature.

It is expected that the *Aquatic Plant Book* will be of use to all people concerned with aquatic ecosystems, from professional botanists to aquatic plant managers to water gardeners.

THE CONTROL OF EUTROPHICATION OF LAKES AND RESERVOIRS edited by S.-O. Ryding and W. Rast, UNESCO. 1989. 314 pages.
(Order from The Parthenon Publishing Group Inc., 120 Mill Road, Park Ridge, New Jersey 07656. $49.00.)

The goal of the editors was to develop a simplified handbook that "focuses on the practical control of eutrophication, as contrasted with a strictly academic treatment of the subject." The book includes everything the layman would want to know about eutrophication: characteristics, "limiting nutrients", factors and processes affecting the degree of eutrophication, the use of models, estimating nutrient loads, methods for sampling, techniques for treating eutrophication, reusing nutrients, and effective management strategies. Two annexes are included: a comprehensive and useful classification system for waterbodies in relation to their desired uses, and a list of case studies of eutrophication control from around the world.

More than 50 scientists, engineers and water managers reviewed and revised this book. In doing so, they have created a tool that meets the needs of many water managers and other water professionals.

AQUATIC AND WETLAND PLANTS OF SOUTH CAROLINA by C.A. Aulbach-Smith, S.J. de Kozlowski, and L.A. Dyck, with illustrations by V.C. Hollowell, South Carolina Water Resources Commission. 1990. 123 pages.
(Order from Publications Coordinator, S.C. Water Resources Commission, 1201 Main Street, Suite 1100, Columbia, South Carolina 29201, (803) 737-0800. $8.00 plus postage.)

This colorful and distinctive "user friendly" identification manual helps identify 88 aquatic plants (including algae) that occur in South Carolina (and southeastern U.S.) waters. Exceptional photographs include habitat, medium and close-up shots of plants. Color coded chapters include 1) submersed, 2) floating, 3) shoreline and wetland, 4) grasses, sedges and rushes, and 5) algae. An illustrated glossary is included.

All proceeds from the book will go into a special account to develop additional public education projects related to aquatic plant management.

FIELD GUIDE TO THE SUBMERGED AQUATIC VEGETATION OF CHESAPEAKE BAY by L.M. Hurley, US Fish and Wildlife Service. 1990. 51 pages.
(Order from US Fish and Wildlife Service, Chesapeake Bay Estuary Program, 180 Admiral Cochrane Drive, Suite 535, Annapolis, Maryland 21401, (301) 224-2735.)

This field guide is a comprehensive look at 14 species of submersed aquatic plants of the Chesapeake Bay. Each plant is well illustrated with color photographs and line drawings. The guide features an easy-to-use key and a glossary. A special feature of the guide is its excellent summary of the general ecology and values of submersed aquatic plants.

PROCEEDINGS, 8TH INTERNATIONAL SYMPOSIUM ON AQUATIC WEEDS, 13-17 August 1990, Uppsala, Sweden, edited by P.R.F. Barrett, M.P. Greaves, K.J. Murphy, A.H. Pieterse, P.M. Wade and M. Wallsten, European Weed Research Society. 1990. 255 pages.
(Order from E.W.R.S. Symposia Proceedings, Post Box 14, NL-6700 AA Wageningen, THE NETHERLANDS.)

This is a collection of 50 papers presented at the EWRS 8th Symposium, including papers on aquatic weed ecology, biology, and management.

SAGO PONDWEED (POTAMOGETON PECTINATUS L.): A LITERATURE REVIEW by H.A. Kantrud, US Fish and Wildlife Service, Resource Publication 176. 1990. 89 pages.
(Order from Publications Unit, US Fish and Wildlife Service, 18th and C Streets, N.W., Arlington Square Building, Mail Stop 1111, Room 130, Washington, D.C. 20240.)

Sago pondweed is an important aquatic food plant for waterfowl. This comprehensive literature review (several hundred sources) compiles what is known of the plant's physiol-

ogy, morphology, ecology, propagation, economics and control.

THE ESTUARY AS A FILTER edited by V.S. Kennedy, Academic Press. 1984. 511 pages.
(Order from Academic Press, P.O. Box 96448, Chicago, Illinois 60693. $49.00.)

Estuaries "tie together terrestrial, freshwater, and marine biomes, weave a web of complexity far greater than that of their three contributor systems and far out of proportion to their occupation of less than 1% of the planet's surface." Barbara L. Welsh.

This collection of 23 papers describes the "filtering" processes of estuaries. Physical, geological, chemical-geochemical, and biological processes are described, and management implications are discussed.

One paper (Kemp, Boynton, Twilley) describes the physical, chemical and biological influences of the aquatic plants *Potamogeton perfoliatus* and *Ruppia maritima*. The paper also presents data on the reasons for reduced water turbidity over plant beds.

EFFECTS OF SALINITY AND IRRADIANCE CONDITIONS ON THE GROWTH, MORPHOLOGY AND CHEMICAL COMPOSITION OF SUBMERSED AQUATIC MACROPHYTES by R.R. Twilley and J.W. Barko, US Army Engineer Waterways Experiment Station. Technical Report A-90-5. 1990. 29 pages.
(Order from National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, (703) 487-4650.)

The growth, morphology and chemical composition of *Hydrilla verticillata, Myriophyllum spicatum, Potamogeton perfoliatus* and *Vallisneria americana* were compared among different salinity and light conditions. Except for hydrilla, the plants were able to adapt to salinities one-third the strength of seawater.

EFFECTS OF WATER CHEMISTRY ON SUBMERSED AQUATIC PLANTS: A SYNTHESIS, by R.M. Smart, US Army Engineer Waterways Experiment Station. Miscellaneous Paper A-90-4. 1990. 22 pages.
(Order from National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, (703) 487-4650.)

This is a review of the literature on the effects of water chemistry on the growth and distribution of submersed aquatic plants. Emphasis is on the factors that control the supply of inorganic carbon to the plants. These factors include alkalinity, dissolved inorganic carbon and pH.

USE OF VEGETATION IN CIVIL ENGINEERING, edited by N.J. Coppin and I.G. Richards, Construction Industry Research and Information Association, Butterworths. 1990. 292 pp.
(Order from Butterworths, 80 Montvale Avenue, Stoneham, MA 02180 (617) 438-8464. $65.00.)

Written for the practicing civil engineer, this comprehensive guidebook concerns the use of vegetation "as a way of reducing the visual impact of civil engineering works and enhancing the quality of the landscape."

The book includes sections on basic aspects of vegetation; physical effects of vegetation; vegetation selection, establishment and management; method of approach and implementation; and applications.

The book also includes a section about the use of plants for watercourse and shoreline protection. As engineers, the editors recognize the water-flow problems caused by some aquatic weeds; however, they still promote the use of shoreline plants and trees to enhance the visual and ecological appeal of canals and rivers.

MICROBIOLOGICAL CONTROL OF EURASIAN WATERMILFOIL - Final Report, by H.B. Gunner, Y. Limpa-amara, B.S. Bouchard, P.J. Weilerstein and M.E. Taylor, University of Massachusetts. US Army Engineer Waterways Experiment Station. Technical Report A-90-2. 1990. 125 pp.
(Order from National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, (703) 487-4650.)

Two pathogens (the fungus, *Mycoleptodiscus terrestris* and a bacteria, *Bacillus* sp. strain P8) were isolated from *Myriophyllum spicatum* and cultured. The pathogens were applied to watermilfoil in laboratory and natural lake settings. Field applications "ultimately resulted in the virtual elimination of *M. spicatum* from a treated plot within 10 weeks."

PROCEEDINGS OF THE CALIFORNIA EELGRASS SYMPOSIUM, May 27 and 28, 1988, Chula Vista, California, edited by K.W. Merkel, R.S. Hoffman and J.L. Stuckrath, Sweetwater River Press. 1990. 78 pages.
(Order from Pacific Southwest Biological Services, P.O. Box 985, National City, California 92050, (619) 477-5333.)

Eelgrass (*Zostera marina*) meadows provide nurseries for a diversity of marine plants and animals. These ten scientific papers discuss management practices for eelgrass, with special emphasis on transplantation projects to restore eelgrass meadows in the Pacific.

DISTRIBUTION OF SUBMERGED AQUATIC VEGETATION IN THE CHESAPEAKE BAY, by R.J. Orth and J.F. Nowak, Virginia Institute of Marine Sciences. 1990. 249 pages.
(Order from U.S. Environmental Protection Agency, Chesapeake Bay Program, Annapolis, Maryland 21403.)

This report contains numerous maps showing areas having submersed aquatic plants in the Bay. Twenty-one species were mapped.

TIDAL MARSH PLANTS by L.N. Eleuterius, Gulf Coast Research Laboratory, Pelican Publishing Company. 1990. 160 pp.
(Order from Pelican Publishing Company, 1101 Monroe Street, P.O. Box 189, Gretna, Louisiana 70053 (504) 368-1175. $24.95.)

This is a field guide to the 200 most common vascular plants found in salt marshes of the U.S. Atlantic and Gulf coasts.

Rather than use a taxonomic key, the user scans line drawings to identify plants. Simple field descriptions and distribution information accompany each drawing. Many plants are further illustrated in color plates. A glossary of botanical terms, and a section of labelled illustrations of plant parts enhance the usefulness of this field guide.

FROM THE DATABASE

Here is a sampling of the research articles, books and reports which have been entered into the aquatic plant database since April, 1990.

To receive free bibliographies on specific plants and/or subjects, contact APIRS at the address shown on the mail label on page 16. The database has more than 28,000 items.

To obtain articles, contact your nearest state or university library.

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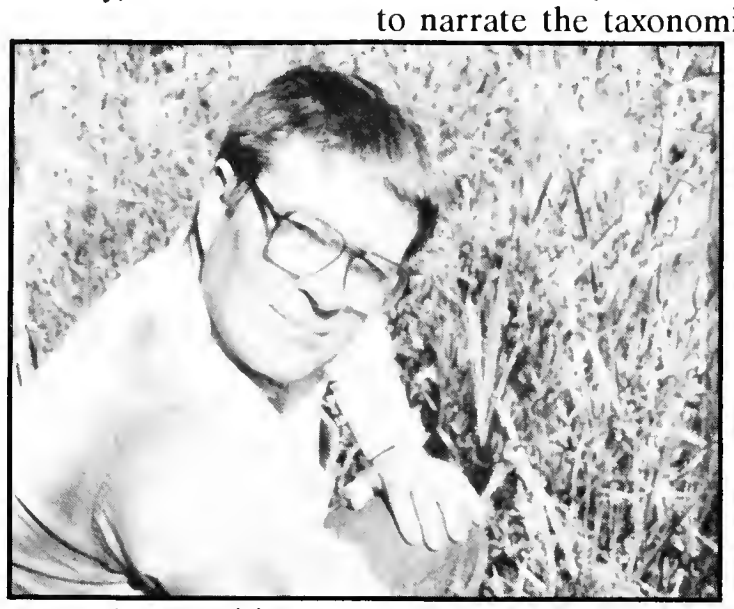
DAVE HALL - A BUSY MAN

These days, sloshing through lakes, rivers and wetlands, lurking in woods and fields, and peering at plants through a lens can arouse all sorts of suspicions. Before you call the authorities, however, take a closer look. It could be Dr. David Hall, Extension Botanist for the University of Florida's Institute of Food and Agricultural Sciences. Among other things, Hall is an expert on the aquatic plants in Florida. Working at the university since 1971, his main responsibility is plant identification, serving county extension and other university faculty, and other state agency personnel. He identifies close to 7,000 plants a year. He also presents plant identification short courses to groups such as aquatic plant managers, crop farmers, horticulturists, aquaculturists, roadside management crews, foresters, and students.

There are about 250,000 vascular plant species in the world, several thousand of which are considered weeds. There are more than 3,800 plant species in Florida, of which about 750 are considered weeds. Correct identification is essential to determine a plant's toxicity, edibility, horticultural value, growth characteristics, weed potential, and relationships to other plants. In this respect, botanists such as Dave Hall are indispensable. According to Hall, however, what we don't know about plants exceeds what we do know. This lack of information makes knowledge of plant relationships of critical importance. If many plants in a family are known to be toxic or to have great weed potential, it is safe to assume that others in the same family pose similar threats until good biological information is obtained. Good biological information includes the correct name, habitat, growth conditions, flowering period, pollination and germination habits, seed period, anatomy and physiology. Information of this type exists for only a small percentage of the weed species in the world. In Florida, this figure drops to about 5%. Hall says he has learned of most weeds by people contacting him about problem plants. After identifying the species using taxonomic keys and herbarium specimens, he refers people to control experts. This function ties in directly with Dave's favorite part of the job, which is helping and working with people.



Hall is the son of an orchid growing father and a college librarian mother, so it seems only natural that he would choose a career as a sort of plant librarian. He holds a degree in botany from Georgia Southern College and advanced degrees in systematic botany from G.S.C. and U.F.

A typical day for Hall could include a plant identification course, where he meets with a group of people to teach identifying characteristics using plant specimens. He also regularly identifies plants for border inspectors guarding against prohibited plant importations, for farmers troubled by noxious weed species, for archaeologists seeking information about ancient, excavated plant remains, for horticulturists or agronomists seeking to breed new hybrids, and even for the police.

FORENSIC BOTANY

One of Hall's more novel duties is that of forensic botanist, which is the application of botany to criminal investigations. Hall has assisted in civil cases as well as several felony investigations. He has been able to place suspects at crime scenes by identifying plant fragments found both at the scene and on the suspect's clothing, vehicle or weapon. Botanical evidence, such as dried leaves stuck to a car or a sapling growing up through a skeleton, can help pinpoint the time a crime was committed.

BOTANICAL VIDEOS

Most recently, Hall has been assisting in the production of aquatic plant identification videos. Working both in the field and in the studio, Hall has teamed up with the Center video staff to identify and videotape aquatic plants in the field, and to narrate the taxonomic information necessary for identification. Four tapes will be produced - floating and floating-leaved plants, submersed plants, emersed plants, and grasses, sedges and rushes. Videotapes should be available in 1991 for anyone interested in learning to identify aquatic plants.

PUBLICATIONS

Hall is currently working on several publications such as a book on Florida wildflowers, and a book on turfgrass weeds for the southeastern United States that will describe approximately 200 species that occur from Virginia to Key West. He co-authored the popular *Identification Manual for Wetland Plant Species of Florida,* which is being republished after the initial 3,500 copies quickly sold out. He recently completed *Weeds in Florida*, describing 40 terrestrial and aquatic weeds of economic significance in Florida, and contributed to *Florida Weeds, Part II, A Supplement to Weeds of the Southern United States*, covering 50 Florida weed species. Hall also contributes heavily to the weed identification guide of the Southern Weed Science Society, which so far has described 250 species and produces supplements in packages of 50 species (does not yet cover aquatics). Perhaps his largest ongoing project has been a fully illustrated taxonomic manual on all cultivated and native grasses in Florida, which is 95% complete.

What comes next in the line-up of duties for UF's willing and versatile extension botanist? One never knows, but the possibilities seem endless.

Dr. David Hall can be contacted at the University of Florida Herbarium, 209 Rolfs Hall, Gainesville, Florida 32611, (904)392-1767. For help with plant identification, you should first contact your county extension agent.

WHAT'S A HERBARIUM?

A herbarium is a museum collection of dried plant specimens. The largest herbarium in the world is in the Museum National d'Histoire Naturelle in Paris (established in 1635) with almost 9 million specimens. The Royal Botanical Gardens at Kew house the second largest collection with 6 million specimens. The Komarov Botanical Institute in Leningrad houses 5.8 million. The University of Florida Herbarium contains almost 500,000 specimens (including bryophytes, lichens, fungi, and a paleobotanical collection), about 200,000 of which are vascular plant specimens. Started in the 1890's, it is one of the largest herbariums in the southeastern United States and is the official state herbarium through the Florida Museum of Natural History.

Herbarium collections are to be maintained in perpetuity, and some plant specimens date from the 1500's. Cellulose in the plants holds them together after they are dried, pressed and affixed to a firm, acid-free backing. Backings are replaced and plants are repaired in a constant effort to maintain the collection. Specimens can be destroyed by insects, bacteria and fungi attracted to plant sugars. For this reason, they are protected in insect-proof metal cabinets. Because the specimens are very fragile, access to the collection is restricted to staff members or herbarium researchers trained in plant systematics. Members of the general public can obtain information from the herbarium through the Extension Service or by appointment with herbarium staff.

Herbariums around the world both loan out and trade specimens to save time and money, and to diversify their research material. New specimens are identified using taxonomic keys and other herbarium specimens. Specimens are labeled with the scientific name, the plant habit and frequency, the date and location of collection, the collector's name, and a collection number. They are then cataloged and filed with other specimens of the same plant family, genus and species.

Herbariums need all forms of a plant, including different growth stages, root systems, different ranges and habitats. Many common plants are still not on file at the UF Herbarium, and the aquatic plant collection is particularly incomplete. Anyone wishing to submit a plant specimen should press the plant between sections of newspaper and place it between cardboard. Standard specimen size is 11" x 16". Specimens should be noted with the date and location of collection and the collector's name, as well as with any descriptive information that may be lost when the plant is pressed, such as flower color, fragrance, abundance of the plant, and so on. It is advisable to call the herbarium before contributing specimens to ask if that particular plant species is needed in the collection.

Send samples to the University of Florida Herbarium, 209 Rolfs Hall, 322 IFAS, Gainesville, Florida 32611, (904)392-1767.

MEETINGS

INTERNATIONAL SYMPOSIUM ON THE BIOLOGY AND CONTROL OF AQUATIC PLANTS, A Joint Meeting with the Aquatic Plant Management Society. July 12-17, 1992, Daytona Beach, Florida.

Plans are being made and a circular is being developed. Subject areas that will be included are the ecology and photosynthesis of aquatic plants, use of plant biology to develop better control methods, and environmental impacts of various management options. Post-meeting field trips to the Central Florida and Everglades areas are being planned.

For the first circular, contact Dr. George Bowes, Botany Department, University of Florida, Gainesville, Florida 32611. APMS members will receive the first circular in upcoming newsletters.

1ST SYMPOSIUM ON ENVIRONMENTAL TOXICOLOGY AND RISK ASSESSMENT: AQUATIC, PLANT AND TERRESTRIAL. April 14-16, 1991, Atlantic City, New Jersey.

Topics for this symposium will range from basic metabolism, mechanisms of toxicity and pharmacokinetics, to the effects of xenobiotics on ecosystem structure and research needs in risk assessment. A special session on sediment toxicology is also planned.

For more information, contact symposium chairman Wayne Landis, Huxley College, Environmental Studies, Western Washington University, Bellingham, Washington 98225, (206) 647-6109.

25TH ANNUAL MEETING OF THE AQUATIC PLANT CONTROL RESEARCH PROGRAM (APCRP). November 26-30, 1990, Marriott Hotel, Orlando, Florida.

For more information, contact J.L. Decell, Manager, APCRP, Corps of Engineers, Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199.

18TH ANNUAL CONFERENCE ON WETLANDS RESTORATION AND CREATION. May 16-17, 1991, Sheraton Grand Hotel, Tampa, Florida.

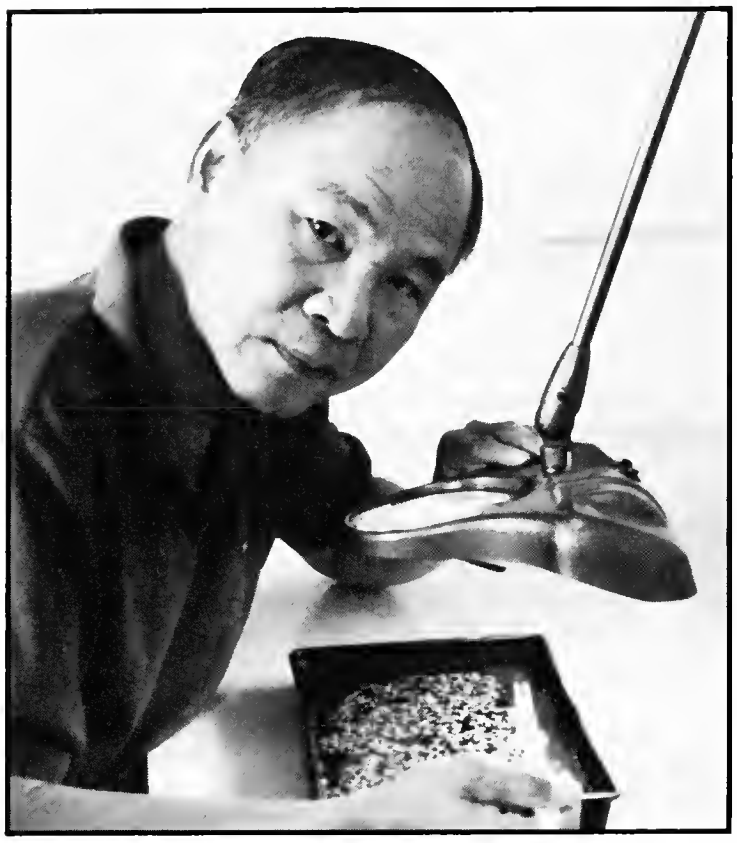
This annual forum presents results of research in the restoration, creation and management of freshwater and coastal wetland systems.

For more information, contact F.J. Webb, Hillsborough Community College, Plant City Campus, 1206 N. Park Road, Plant City, Florida 33566, (813) 757-2104.

[From TOXICITY TESTING on page 1]

(Wang, 1990). This review article concentrates on duckweed test methodology, especially with regard to test species, test types, test vessels, control tests, nutrient media, test end points, and test results. All available results on the use of duckweed for single compounds, complex mixtures, and effluent toxicity testing are tabulated.

Two duckweed species are most commonly used for toxicity testing: *Lemna gibba* and *Lemna minor.* A wealth of information is available on both species. Duckweed has been tested with static, renewal, and flow-through test methods (Wang, 1986a; Walbridge, 1977; Davis, 1981). Duckweed can be tested in a single compound or a mixture of compounds, or in complex effluents from municipal or industrial sources. Although some people hold the view that duckweed is not sensitive to toxicity, others consider that duckweed is "simple, sensitive, and cost-effective" as a test species (Wang and Williams, 1988).



Dr. W. Wang selecting duckweed

Several laws recommend the use of duckweed tests. They include the Toxic Substances Control Act; the Federal Insecticide, Fungicide, and Rodenticide Act; and regulations of the Organization for Economic Cooperation and Development. The Clean Water Act and its section on the National Pollutant Discharge Elimination System do not mention duckweed tests. Recently, however, the U.S. Environmental Protection Agency (USEPA) Duluth Environmental Research Laboratory and the National Effluent Toxicity Assessment Center have placed emphasis on duckweed tests as a substitute for algal tests for effluent toxicity assessment (Taraldsen and Norberg-King, 1990).

Two organizations are currently developing separate consensus duckweed test protocols. The American Society for Testing and Materials (ASTM) has been developing a standard test guide since 1983. The guide has gone through seven drafts and is currently under the ASTM committee balloting process. The recommended duckweed species is *Lemna gibba*, and the chairperson of the Duckweed Task Group is Jane Hughes (919-942-3985).

The other organization is the Standard Methods Committee of the American Public Health Association, American Water Works Association, and Water Pollution Control Federation. The Duckweed Joint Task Group (JTG) is chaired by the author and is composed of seven experts from academia, government and industry. The recommended species is common duckweed, *Lemna minor.* The protocol is currently on "proposed" status and will be included in the Standard Methods 17th Edition (Supplement) Section 8211 to be published in 1992.

The experimental conditions for the *Lemna minor* toxicity test as recommended by the Standard Methods Committee are summarized in Table 1. Twenty fronds (10 colonies) are incubated in culture dishes for 120 h. The test end point is the frond increase in each dish. Prior to the test, the duckweed culture must be incubated for two weeks. The water control (and dilution water) is duckweed nutrient medium, i.e., 10-fold the algal nutrient medium.

In addition to duckweed species, other macrophytes have potential for toxicity testing. Japanese millet (barnyard grass, *Echinochloa crusgalli*) is common in the midwestern riverine and lakeshore areas (Bellrose et al., 1983). It is an important food source for waterfowl and its seeds are readily available from seed vendors. Many studies have shown that Japanese millet is a promising macrophyte for toxicity testing of a single compound or complex mixtures (Wang, pending; Wang, 1986b; Wang, 1987; Wang and Williams, 1990). An interesting finding among these studies was that millet and lettuce were especially sensitive to organic and inorganic substances, respectively (Wang, 1987). It was suggested that both millet and lettuce be used for toxicity testing of unknown and/or complex mixtures.

Table 1. Typical toxicity testing conditions for duckweed and other macrophytes.

Test species	*Lemna minor* **(duckweed)**	*Echinochloa crusgalli* **(millet)**
Test type	**Static, renewal, flow-through**	**Static, renewal, flow-through**
Temperature	**27-28 degrees C**	**25-26 degrees C**
Light quality	**86 uE/m^2/s**	**Dark**
Photoperiod	**Continuous**	**Not applicable**
Test vessel	**60 x 15 mm culture dish**	**100 x 15 mm culture dish/filter paper**
Test solution/vessel	**15 mL**	**5 mL**
Test speciments/vessel	**20 fronds (10 colonies)**	**15 seeds**
Replicates	**4**	**4**
Water control and dilution water	**Duckweed nutrient medium, i.e., 10-fold algal nutrient medium**	**Hard, standard water**
Test solution	**120 h**	**120 h**
End point	**Frond count increase**	**Seed germination**

An attempt is being made to standardize toxicity tests involving macrophytes such as Japanese millet. A Macrophyte Joint Task Group (JTG) under the auspices of the Standard Methods Committee was organized in January 1990. The JTG is made up of 11 experts: two from academia, three from the USEPA, one from the U.S. Fish and Wildlife Service, one from the Canadian Fish and Wildlife Service, one from the U.S. Army Corps of Engineers, two from the private sector, and one from a state agency. The chairman is Wuncheng Wang. As of June 1990, the draft has been revised twice. The protocol is assigned as Section 8220 of the Standard Methods 18th Edition, currently in the early planning stage.

In addition to millet, six other macrophytes are also recommended: rice cut-grass (*Zizaniopsis* spp.), American lotus (*Nelumbo lutea*), rice (*Oryza* spp.), watercress (*Nasturtium* spp.) , wild rice (*Zizania aquatica*), all for freshwater, and smooth cordgrass (*Spartina* spp.), for saltwater. Many other common aquatic macrophytes, including water lily (*Nymphaea* spp.), cattail (*Typha* spp.), pondweed (*Potamogeton* spp.) and *Elodea* spp., are potentially useful as toxicity testing species. Many studies will be required to explore their potential and limitations.

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VIDEOPHILE

WaterRich WaterPoor

In the drought-stricken Southwest Florida Water Management District, too many people want to use more water than the district has. How can the people of the district work together to assure a good supply of water for agricultural, industrial and residential consumers?

Management choices (water-use restrictions) are made by the SWFWMD governing board, based on the expertise of some 700 district employees. This video is a good introduction to the magnitude of the water shortage problem and describes in general terms how all district inhabitants can reduce their use of water.

For information on this 28 minute VHS video, contact the office of Public Communications, SWFWMD, 2379 Broad Street, Brooksville, Florida 34609-6899, (904) 796-7211.

CLEAR WATERS - Managing South Florida's Aquatic Plants

This well produced 23-minute videotape program introduces the aquatic plant management work of the South Florida Water Management District. Herbicidal, biological and mechanical methods are also reviewed.

For more information, contact Mike Bodle, South Florida Water Management District, P.O. Box 24680, West Palm Beach, Florida 33416-4680, (407) 687-6132.

SAMPLING AQUATIC INSECTS

This practical videotape for water researchers demonstrates the use of 23 methods and devices for collecting insects in and around aquatic sites. The 36-minute program is intended to help researchers in the study design process. It was written and produced by V.H. Resh, J.W. Feminella and E.P. McElravy, entomologists at the University of California at Berkeley.

For more information, contact the Office of Media Services, University of California, Berkeley, CA 94720.

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AQUAPHYTE

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EDITORS: Victor Ramey
Karen Brown

AQUAPHYTE is sent to 3,000 U.S. and Canadian managers, researchers and agencies. Comments, announcements, news items and other information relevant to aquatic plant research are solicited.

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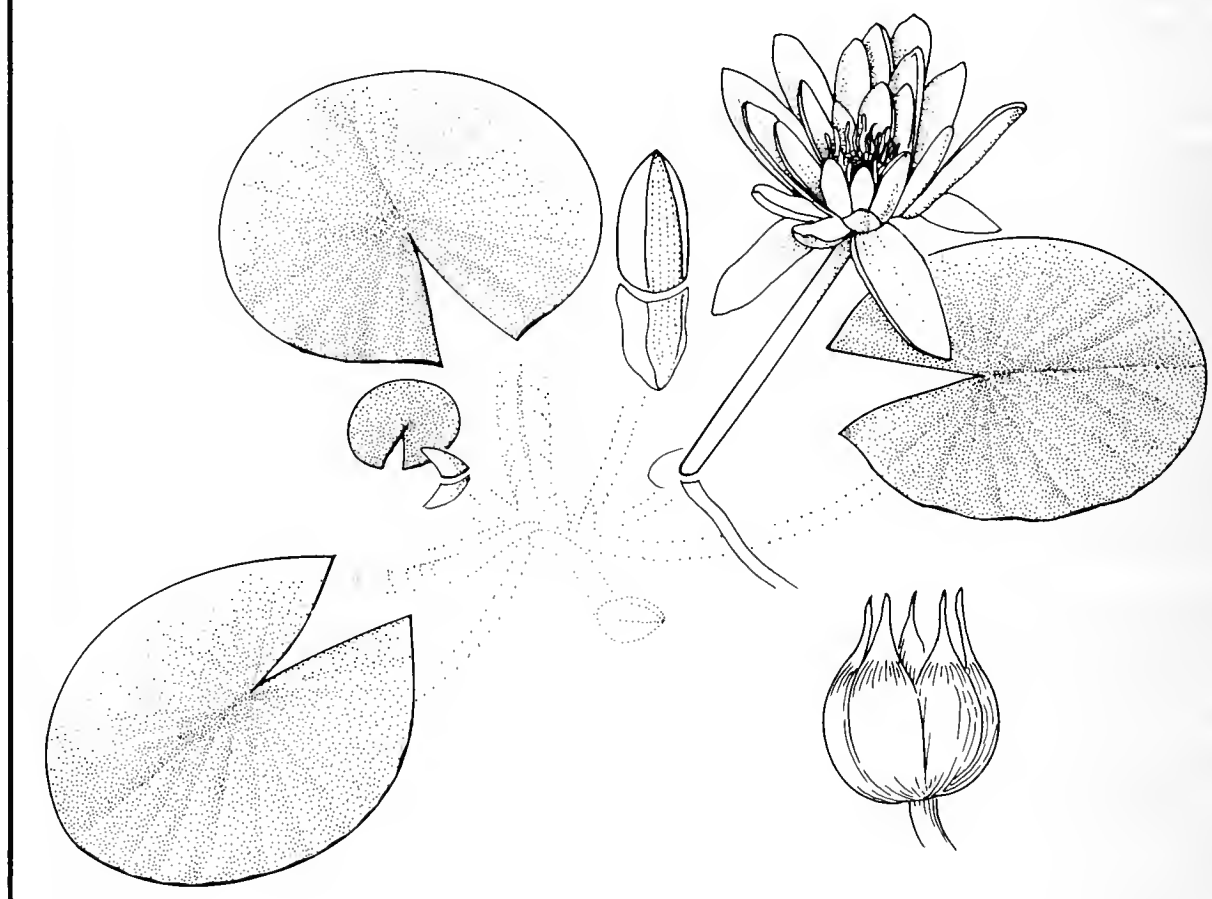

Nymphaea odorata
Fragrant water lily

"**AGAIN** I scent the white water-lily, and a season I had waited for is arrived. It is the emblem of purity and its scent suggests it. Growing in stagnant and muddy water, it bursts up so pure and fair to the eye and so sweet to the scent, as if to show us what purity and sweetness reside in, and can be extracted from, the slime and muck of earth. What confirmation of our hopes is in the fragrance of the water-lily! I shall not so soon despair of the world for it." *Henry D. Thoreau*

from *Thoreau on Man and Nature*, compiled by Arthur G. Volkman, Peter Pauper Press, Inc., Mt. Vernon, New York, p. 51.